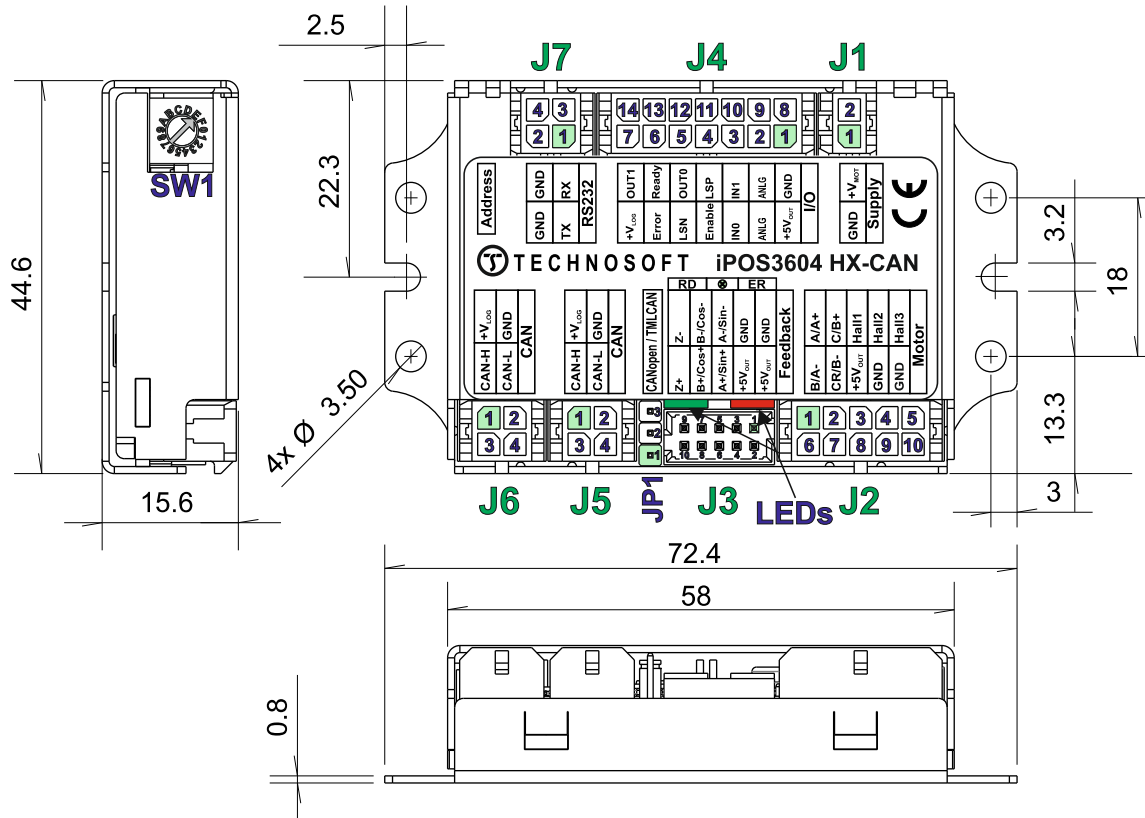




# iPOS3604 HX-CAN Differential DATASHEET

P/N: P028.001.E501



All dimensions are in mm.

Motor – sensor configurations						
Sensor	Motor	PMSM	BLDC	DC BRUSH	STEP (2-ph)	STEP (3-ph)
	Incr. Encoder	✓			✓	✓
Incr. Encoder + Hall	✓	✓				
Analog Sin/Cos encoder	✓					
Tacho				✓		
Open-loop (no sensor)					✓	✓

Mating Connectors				
Producer	Part No.	Connector	Description	Wire Gauge
MOLEX	43025-0200	J1	MICROFIT RECEPTACLE HOUSING, 2x1 WAY	AWG 20..24
MOLEX	43025-0400	J5, J6, J7	MICROFIT RECEPTACLE HOUSING, 2x2 WAY	AWG 20..24
MOLEX	43025-1000	J2	MICROFIT RECEPTACLE HOUSING, 2x5 WAY	AWG 20..24
MOLEX	43025-1400	J4	MICROFIT RECEPTACLE HOUSING, 2x7 WAY	AWG 20..24
MOLEX	43030-0007	J1, J2, J4, J5, J6, J7	CRIMP PIN, MICROFIT, 5A	AWG 20..24
MOLEX	51110-1056	J3	MILLIGRID RECEPTACLE HOUSING, 2x5 WAY	AWG 24..30
MOLEX	50394-8400	J3	CRIMP PIN, MILLIGRID	AWG 24..30

## Features

- Motor supply: 9-36V. Optional logic supply: 9-36V
- Output current: 4A cont. (BLDC mode); 10A<sub>PEAK</sub>, up to 100KHz PWM
- Digital Hall sensor interface (single-ended, open collector and differential)
- Sin/Cos encoder interface (1V<sub>pp</sub>)
- Incremental differential encoder interface
- 5 digital inputs, 5-36V, PNP or NPN software selectable: Enable, 2 for limit switches, 2 general-purpose
- 4 digital outputs, 5-36V, 0.5A, NPN open-collector: Ready, Error, 2 general-purpose
- 1 analogue input: 12-bit, 0-5V: Reference or feedback or general purpose
- RS-232 serial & CAN-bus 2.0B interfaces with H/W selectable addresses
- TMLCAN and CANopen (CiA 301 v4.2 and CiA 402 v3.0) protocols selectable by jumper
- 2K × 16 SRAM for data acquisition
- 4K × 16 E<sup>2</sup>ROM to store TML motion programs and data
- Operating ambient temperature: 0-40°C (over 40°C with derating)
- Hardware Protections: short-circuit between motor phases and from motor phases to GND, over-voltage, under-voltage and I<sup>2</sup>t
- Firmware: F509M+

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## Connector Description

Pin	Name	Type	Description
J1	1	GND	- Negative return (ground) of the power supply
	2	+VMOT	I Positive terminal of the motor supply: 9 to 36V <sub>DC</sub> / Positive terminal of the internal logic supply if J4 pin 7 not connected (I/Os work only when J4 pin 7 is connected)

Pin	Name	Type	Description
J2	1	A/A+	O Phase A for 3-ph motors, A+ for 2-ph steppers, Motor+ for DC brush motors
	2	C/B+	O Phase C for 3-ph motors, B+ for 2-ph steppers
	3	Hall 1	I Digital input Hall 1 sensor
	4	Hall 2	I Digital input Hall 2 sensor
	5	Hall 3	I Digital input Hall 3 sensor
	6	B/A-	O Phase B for 3-ph motors, A- for 2-ph steppers, Motor- for DC brush motors
	7	CR/B-	O Chopping resistor / Phase B- for step motors
	8	+5V <sub>OUT</sub>	O 5V output supply - internally generated
	9	GND	- Negative return (ground) of the motor supply
	10	GND	- Negative return (ground) of the motor supply

Pin	Name	Type	Description
J3	1	GND	- Return ground for sensors supply
	2	+5V <sub>OUT</sub>	O 5V output supply for I/O usage
	3	GND	- Return ground for sensors supply
	4	+5V <sub>OUT</sub>	O 5V output supply for I/O usage
	5	A-/Sin-	I Incr. encoder A- diff. input, or analogue encoder Sin- diff. input
	6	A+/Sin+	I Incr. encoder A+ diff. input, or analogue encoder Sin+ diff. input
	7	B-/Cos-	I Incr. encoder B- diff. input, or analogue encoder Cos- diff. input
	8	B+/Cos+	I Incr. encoder B+ diff. input, or analogue encoder Cos+ diff. input
	9	Z-	I Incr. encoder Z- diff. input,
	10	Z+	I Incr. encoder Z+ (index) diff. input

Pin	Name	Type	Description
J5, J6	1	+V <sub>LOG</sub>	O Positive terminal of the logic supply: 9 to 36V <sub>DC</sub>
	2	GND	- Return ground for CAN-Bus
	3	Can-Hi	I/O CAN-Bus positive line (dominant high)
	4	Can-Lo	I/O CAN-Bus negative line (dominant low)

Pin	Name	Type	Description
J7	1	232TX	O RS-232 Data Transmission
	2	GND	- Return ground for RS-232 pins
	3	232RX	I RS-232 Data Reception
	4	GND	- Return ground for RS-232 pins

Pin	Name	Type	Description
J4	1	+5V <sub>OUT</sub>	O 5V output supply for I/O usage
	2	ANLG	I Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or an analogue position or speed feedback or as general purpose analogue input
	3	IN0	I 5-36V general-purpose digital PNP/NPN input
	4	IN4/Enable	I 5-36V digital PNP input. Drive enable input
	5	IN3/LSN	I 5-36V digital PNP input. Negative limit switch input
	6	OUT2/Error	O 5-36V 0.5A, drive Error output, active low, NPN open-collector/TTL pull-up. Also drives the red LED
	7	+V <sub>LOG</sub> <sup>1</sup>	I Positive terminal of the logic supply for inputs and outputs operation: 9 to 36V <sub>DC</sub>
	8	GND	- Return ground for I/O pins
	9	ANLG	I Analogue input, 12-bit, 0-5V. Used to read an analog position, speed or torque reference, or an analogue position or speed feedback or as general purpose analogue input
	10	IN1	I 5-36V general-purpose digital PNP/NPN input
	11	IN2/LSP	I 5-36V digital PNP/NPN input. Positive limit switch input
	12	OUT0	O 5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up
	13	OUT3/Ready	O 5-36V 0.5A, drive Ready output, active low, NPN open-collector/TTL pull-up. Also drives the green LED.
	14	OUT1	O 5-36V 0.5A, general-purpose digital output, NPN open-collector/TTL pull-up

Position	Description
J4, 1-2	Select CANopen communication protocol
J4, 2-3	Select TMLCAN communication protocol

## Electrical characteristics

All parameters measured under the following conditions (unless otherwise specified):

- Tamb = 0...40°C, VLOG = 24 VDC; VMOT = 36VDC
- Supplies start-up / shutdown sequence: -any-
- Load current (sinusoidal amplitude / continuous BLDC, DC, stepper) = 4A

Operating Conditions		Min.	Typ.	Max.	Units
Ambient temperature <sup>2</sup>		0		+40	°C
Ambient humidity	Non-condensing	0		90	%Rh
Altitude / pressure <sup>3</sup>	Altitude (vs. sea level)	-0.1	0 + 2.5	<sup>2</sup>	Km
	Ambient Pressure	0 <sup>2</sup>	0.75 + 1	10.0	atm
Storage Conditions		Min.	Typ.	Max.	Units
Ambient temperature		-40		+85	°C
Ambient humidity	Non-condensing	0		100	%Rh
Ambient Pressure		0		10.0	atm
Mechanical Mounting		Min.	Typ.	Max.	Units
Airflow		natural convection <sup>4</sup> , closed box			
Environmental Characteristics		Min.	Typ.	Max.	Units
Size (Length x Width x Height)	Without mating connectors	72.4 x 44.6 x 15.6			mm
		~2.85 x 1.76 x 0.61			inch
Weight	Without mating connectors	48			g
Power dissipation	Idle (no load)	1			W
	Operating	3			5
Efficiency		98			%
Cleaning agents	Dry cleaning is recommended	Only Water- or Alcohol- based			
Protection degree	According to IEC60529, UL508	IP20			-

<sup>1</sup> If +V<sub>LOG</sub> (J4 pin7) is not connected, the digital outputs and inputs will not be operational.

<sup>2</sup> Operating temperature can be extended up to +65°C with reduced current and power ratings.

<sup>3</sup> iPOS360x can be operated in vacuum (no altitude restriction), but at altitudes over 2,500m, current and power rating are reduced due to thermal dissipation efficiency.

<sup>4</sup> It is recommended to mount the iPOS3604 HX-CAN on a metallic support using the provided mounting holes, for better reliability and reduced de-rating due to heat dissipation

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Logic Supply Input (+V <sub>LOG</sub> )		Min.	Typ.	Max.	Units	
Supply voltage	Nominal values	9		36	V <sub>DC</sub>	
	Absolute maximum values, drive operating but outside guaranteed parameters	5.9		39	V <sub>DC</sub>	
	Absolute maximum values, continuous	0		39	V <sub>DC</sub>	
Supply current	No Load on Digital Outputs	+V <sub>LOG</sub> = 9V	125	300	mA	
		+V <sub>LOG</sub> = 12V	80	200		
		+V <sub>LOG</sub> = 24V	50	125		
		+V <sub>LOG</sub> = 39V	40	100		
<b>Motor Supply Input (+V<sub>MOT</sub>)</b>		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>	
Supply voltage	Nominal values	9		36	V <sub>DC</sub>	
	Absolute maximum values, drive operating but outside guaranteed parameters	8.5		40	V <sub>DC</sub>	
	Absolute maximum values, continuous	0		42	V <sub>DC</sub>	
Supply current	Idle	Absolute maximum values, surge (duration ≤ 10ms) †	0	+45	V	
		Operating	-3.2	±2	+3.2	mA
		Absolute maximum value, short-circuit condition (Duration ≤ 10ms) †			5	A
<b>Motor Outputs (A/A+, B/A-, C/B+, CR/B-)</b>		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>	
Nominal output current, continuous	for DC brushed, steppers and BLDC motors with Hall-based trapezoidal control			4	A	
	for PMSM motors with FOC sinusoidal control (sinusoidal amplitude value)			4		
	for PMSM motors with FOC sinusoidal control (sinusoidal effective value)			2.82		
Motor output current, peak	maximum 2.5s	-10		+10	A	
Short-circuit protection threshold			±13	±15	A	
Short-circuit protection delay		5	10		µs	
On-state voltage drop	Nominal output current; including typical mating connector contact resistance		±0.3	±0.5	V	
Off-state leakage current			±0.5	±1	mA	
Motor inductance (phase-to-phase)	Recommended value, for current ripple max. ±5% of full range; +V <sub>MOT</sub> = 36 V	F <sub>PWM</sub>			µH	
		20 kHz	250			
		40 kHz	120			
	Minimum value, limited by short-circuit protection; +V <sub>MOT</sub> = 36 V	60 kHz	100		µH	
		80 kHz	60			
		100 kHz	45			
Motor electrical time-constant (L/R)	Recommended value for ±5% current measurement error	20 kHz	250		µs	
		40 kHz	125			
		60 kHz	100			
		80 kHz	63			
		100 kHz	50			
Current measurement	FS = Full Scale accuracy		±4	±8	%FS	
<b>Supply Output (+5V)</b>		<b>Min.</b>	<b>Typ.</b>	<b>Max.</b>	<b>Units</b>	
Output voltage	Current sourced = 250mA	4.8	5	5.2	V	
Output current		250	350		mA	
Short-circuit		NOT protected				
Over-voltage		NOT protected				
ESD protection	Human body model	±1			kV	

Digital Inputs (IN0, IN1, IN2/LSP, IN3/LSN, IN4/Enable)		Min.	Typ.	Max.	Units
Mode compliance	PNP				
Default state	Input floating (wiring disconnected)	Logic LOW			
Input voltage	Logic "LOW"		0	1.6	V
	Logic "HIGH"	1.8	24	39	
	Floating voltage (not connected)		0		
	Absolute maximum, continuous	-10		+39	
Input current	Absolute maximum, surge (duration ≤ 1s) †	-20		+40	mA
	Logic "LOW"; pulled to GND		0	0	
	Logic "HIGH"		2.9	3.4	

Mode compliance		NPN/ TTL / CMOS / LVTTTL (3.3V) / Open-collector			
Default state	Input floating (wiring disconnected)	Logic HIGH			
Input voltage	Logic "LOW"	2	5+24		V
	Logic "HIGH"		3		
	Floating voltage (not connected)	-10		+30	
	Absolute maximum, continuous	-20		+40	
Input current	Absolute maximum, surge (duration ≤ 1s) †	2	5+24		mA
	Logic "LOW"; Pulled to GND		0.6	1	
	Logic "HIGH"; Internal 4.7KΩ pull-up to +3.3	0	0	0	
	Logic "HIGH"; Pulled to +5V		0.15	0.2	
	Logic "HIGH"; Pulled to +24V		2	2.5	

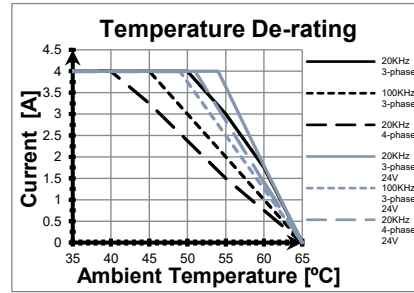
Input frequency		0		150	kHz
Minimum pulse		3.3			µs
ESD protection	Human body model	±5			kV

Digital Outputs (OUT0, OUT1, OUT2/Error, OUT3/ Ready)		Min.	Typ.	Max.	Units	
Mode compliance		TTL / CMOS / Open-collector / NPN 24V				
Default state	Not supplied (+V <sub>LOG</sub> floating or to GND)	High-Z (floating)				
	Immediately after power-up	OUT0, OUT1	Logic "HIGH"			
		OUT2/Error, OUT3/ Ready	Logic "LOW"			
Normal operation	OUT0, OUT1, OUT2/Error	Logic "HIGH"				
	OUT3/Ready	Logic "LOW"				
Output voltage	Logic "LOW"; output current = 0.5A		0.2	0.8	V	
	Logic "HIGH"; output current = 0, no load	2.9	3	3.3		
		OUT2/Error, OUT3/ Ready	4	4.5		5
	Logic "HIGH", external load to +V <sub>LOG</sub>		V <sub>LOG</sub>			
	Absolute maximum, continuous	-0.5		V <sub>LOG</sub> +0.5		
	Absolute maximum, surge (duration ≤ 1s) †	-1		V <sub>LOG</sub> +1		
Output current	Logic "LOW", sink current, continuous			0.5	A	
	Logic "LOW", sink current, pulse ≤ 5 sec.			1	A	
	Logic "HIGH", source current; external load to GND; V <sub>OUT</sub> ≥ 2.0V			2	mA	
		OUT2/Error, OUT3/ Ready			4	mA
		OUT0, OUT1			4	mA
	Logic "HIGH", leakage current; external load to +V <sub>LOG</sub> ; V <sub>OUT</sub> = V <sub>LOG</sub> max = 40V		0.1	0.2	mA	
Minimum pulse width		2			µs	
ESD protection	Human body model	±15			kV	

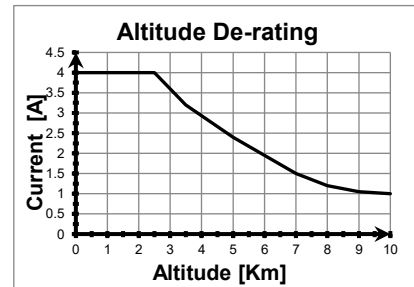
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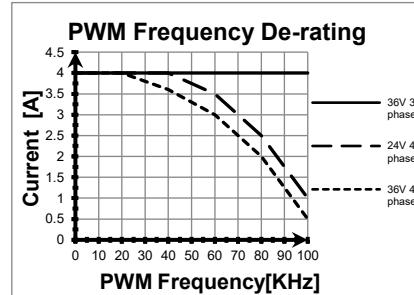
Digital Hall Inputs (Hall1, Hall2, Hall3)		Min.	Typ.	Max.	Units	
Mode compliance	TTL / CMOS / Open-collector					
Default state	Input floating (wiring disconnected)	Logic HIGH				
Input voltage	Logic "LOW"		0	0.8	V	
	Logic "HIGH"	2	5			
	Floating voltage (not connected)		4.4			
	Absolute maximum, surge (duration ≤ 1s) †	-10		+15		
Input current	Logic "LOW"; Pull to GND			1.2	mA	
	Logic "HIGH"; Internal 4.7kΩ pull-up to +5	0	0	0		
Minimum pulse width		2			μs	
ESD protection	Human body model	±5			kV	
Encoder Inputs (A, B, Z)		Min.	Typ.	Max.	Units	
Input frequency	Single-ended mode, Open-collector / NPN	0		500	kHz	
	Single-ended driven by push-pull (TTL / CMOS)	0		10	MHz	
Minimum pulse width	Single-ended mode, Open-collector / NPN	1			μs	
	Single-ended driven by push-pull (TTL / CMOS)	50			ns	
Input voltage, any pin to GND	Absolute maximum values, continuous	-7		+7	V	
	Absolute maximum, surge (duration ≤ 1s) †	-11		+14		
ESD protection	Human body model	±1			kV	
Analog 0...5V Input (ANLG)		Min.	Typ.	Max.	Units	
Input voltage	Operational range	0		4.95	V	
	Absolute maximum values, continuous	-12		+18		
	Absolute maximum, surge (duration ≤ 1s) †			±36		
Input impedance	To GND		30		kΩ	
Resolution			12		bits	
Integral linearity				±2	bits	
Offset error				±2	±10	bits
Gain error				±1%	±3%	% FS <sup>1</sup>
Bandwidth (-3dB)	Software selectable	0		1	kHz	
ESD protection	Human body model			±5	kV	
RS-232		Min.	Typ.	Max.	Units	
Compliance	TIA/EIA-232-C					
Bit rate	Software selectable	9600		115200	Baud	
Short-circuit	232TX short to GND		Guaranteed			
ESD protection	Human body model	±2			kV	
CAN-Bus		Min.	Typ.	Max.	Units	
Compliance	ISO11898, CiA-301v4.2, 402v3.0					
Bit rate	Software selectable	125		1000	Kbps	
Bus length	1Mbps			25	m	
	500Kbps			100		
	≤ 250Kbps			250		
Resistor	Between CAN-Hi, CAN-Lo	none on-board				
Node addressing	Hardware: by Hex switch	1-15 & 255				
	Software	1 + 127; 255 (CANopen); 1- 255 (TMLCAN)				
Voltage, CAN-Hi or CAN-Lo to GND		-26		26	V	
ESD protection	Human body model	±15			kV	
Conformity		Min.	Typ.	Max.	Units	
EU Declaration	2014/30/EU (EMC), 2014/35/EU (LVD), 2011/65/EU (RoHS), 1907/2006/EC (REACH), 93/68/EEC (CE Marking Directive), EC 428/2009 (non dual-use item, output frequency limited to 590Hz)					



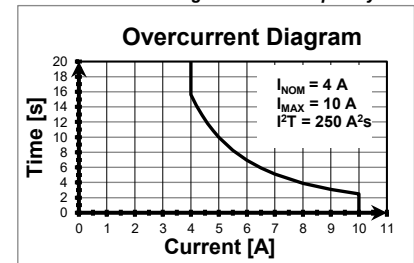
De-rating with ambient temperature



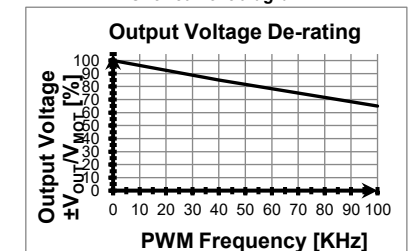
De-rating with altitude



Current De-rating with PWM frequency



Over-current diagram



Output Voltage De-rating with PWM frequency<sup>2</sup>

<sup>1</sup> "FS" stands for "Full Scale"

<sup>2</sup> V<sub>OUT</sub> – the output voltage, V<sub>MOT</sub> – the motor supply voltage

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